Research Assignment

Study Title:

The prevalence of Chronic Kidney Disease and associated factors among adult patients with Type 2 Diabetes Mellitus who attend the Diabetes Centre in Gaborone, Botswana.

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"Declaration

I, the undersigned, hereby declare that the work contained in this assignment is my original work and that I have not previously submitted it, in its entirety or in part, at any university for a degree. I also declare that ethical approval for the study was obtained from the Health Research Ethics Committee of Stellenbosch University (Reference number: S15/01/001)

Signature: Date: 24/02/17"

Abstract

Study Title: The prevalence of Chronic Kidney Disease and associated factors among adult patients with Type 2 Diabetes Mellitus who attend the Diabetes Centre in Gaborone, Botswana.

Background

Chronic Kidney Disease (CKD) is associated with increased cardiovascular morbimortality and overall mortality in patients with diabetes. [1,2] Early detection and prevention of disease progression is therefore pertinent. Presently in Botswana there is no current published research on the prevalence of CKD in this high risk population and this has led to limited opportunities for early detection and availability of Renal Replacement Therapy (RRT).[2]

Aim and Objectives

We conducted this study to determine the prevalence of CKD and associated factors in adult patients with T2DM, and evaluate the management of those with CKD according to established guidelines.

Methods

This cross sectional study consecutively sampled 408 adult patients with T2DM who attended the Diabetes Centre in Gaborone, Botswana. The estimated glomerular filtration rate (eGFR) and albumin creatinine ratio (ACR) were used to define renal function. CKD stages were defined according to the National Kidney Foundation (NKF) classification. Variables studied; socio-demographic and clinical parameters, blood and glycemic control, pharmacological treatments and established complications of diabetes.

Results

The prevalence of CKD was 63.5%(n=259) (95% CI: 58.7% to 68%). Overall albuminuria was observed in 62.59%(n= 255). of the participants. The frequency of the different stageds of CKD in this group was: CKD 1 (53.3%, n=138), CKD 2(29.7%, n=77); CKD 3 (13.9%, n=36); CKD 4(2.3%, n=6) and CKD 5 (0.77 %, n=2). Associated sociodemographic and clinical risk factors: education level, duration of diabetes, BMI, poor glycemic control and the presence of retinopathy. A folder audit on the management of CKD looked at seven quality outcomes; 1) glycemic control, 2) blood pressure control, 3) the use of ACEI/ARB in blood pressure control, 4) the use of ACEI/ARB in the presence of microalbuminuria, 5) the use of Statin in elevated LDL levels, 6) protein restriction and 7) target BMI. There was poor target glycemic and blood pressure control, both of which were not met at 38.2 %(n=99) and 20.9% (n=54) respectively. ACEI/ARB was used in 52.5% (n=136) of patients with hypertension and only 14.0 % (n=36) of those with normal blood pressure and microalbuminuria. Only 40.9% (n=106) of patients with elevated LDL levels were on Statin treatment. Target BMI was achieved in 19.3 %(n= 50) of the patients and protein restriction in only 8.1% (n=21).

Conclusion

The prevalence of CKD is notably high, a large proportion of of which is earlier stages. Management of CKD was generally poor owing to poor screening measures. Periodic screening for albuminuria and eGFR is therefore essential in order to trigger stage appropriate monitoring and treatment.

Introduction

Chronic Kidney Disease (CKD) is defined as: “kidney damage for 3 months as defined by structural or functional abnormalities of the kidneys with or without decreased glomerular filtration rate (GFR), or a GFR of 60 mL/min/ 1.73m^2 or less with or without kidney damage. [1] CKD is associated with significant mortality and morbidity, and is a risk factor for cardiovascular disease (CVD) and End Stage Renal Disease (ESRD). [2,3]

Diabetes Mellitus (DM) has been recognized as one of the leading causes of CKD. [3] In a study done by Nalado et al [4] on the prevalence of risk factors for chronic kidney disease among civil servants in Kano, Nigeria, diabetes had a higher prevalence than other non-communicable diseases, a trend that has been observed in developed

countries. [4,5] It is estimated that a third of patients with T2DM will develop or have developed CKD and that as much as between 10-40 percent of those with T2DM are already affected. [3, 6, 7] As the leading cause of CKD, diabetes is expected to affect more than 366 million people globally by 2030. [8] Out of this 18 million being in sub Saharan Africa alone, projecting an increase of about 161% in the sub Saharan Africa region. [9] Diabetes and CKD are both independently and synergistically associated with cardiovascular disease which contributes to premature death. [5, 10] Several studies [5, 11, 12] have shown that individuals showing evidence of CKD are more likely to develop cardiovascular complications compared to those with normal renal function. In addition there is a high prevalence of CVD in CKD and overall mortality is higher in this population. [13]

Treatment options for CKD are not readily available; however, disease progression may be prevented or delayed by managing associated cardiovascular risk factors like poor glycemic and blood pressure control. [14] Findings from the UKPD study clarified the importance of target glycosylated hemoglobin (HbA1c) of less than 7.0%, in this study; a decrease of HbA1c from 7.9 % to 7.0 % reduced the onset of microalbuminuria by 25% and therefore lowered the risk of microvascular endpoints. [14, 15, 16] The influence of glycemic control has been shown to be greatest in earlier stages of CKD. [14]

In patients with evidence of kidney damage, Renin Angiotensin Aldosterone (RAAS) inhibition has been shown to confer benefit by reducing the rate of progression of albuminuria, promoting regression to normoalbuminuria and even decrease the risk of decline in renal function. [14] Due to their renoprotective effect, Angiotensin Converting Enzyme Inhibitors (ACEI) and Angiotensin II Receptor Blockers (ARB's) should be strongly considered in T2DM patients who are normotensive with evidence of microalbuminuria. [1, 14, 17]

Although there is limited evidence that lipid lowering therapy has any effect of the progression of CKD in patients with T2DM, lipid profiles for this group of patients should be managed according to guidelines for prevention and management of CVD. [18] Statin therapy either as primary or secondary intervention has been shown to produce similar cardio protective effects in both diabetic and non diabetic subjects. [14]

GFR is an ideal way of measuring the level of renal function, but it is logistically impractical for mass screening. [8, 11] As the recommended mode of measuring the true renal function, the estimated GFR is based on serum creatinine, gender, age and race. [8] The National Kidney Foundation Kidney Disease Outcome Quality Initiative (NKF-K/DOQI) guidelines accept both the Modification of Diet in Renal Disease (MDRD) study and Cockcoft-Gault equations for estimating the glomerular function in adults. [8] Current recommendations encourage the use of urine Albumin Creatinine Ratio (ACR) and eGFR for screening, and for patients with T2DM, screening should commence time of diagnosis. [1, 17]

Although CKD is recognized as a major public health problem worldwide, there still exists very limited data on the burden of CKD in sub Saharan Africa. [19,20,21] In spite of evidence that early detection of CKD and management can delay disease progression, early stages of CKD still go undiagnosed and under treated in sub

Saharan Africa leading to significant mortality and morbidity.[19,21] Contributing factors include poor awareness of CKD leading to ineffective screening measures, lack of resources resulting in limited screening and late diagnosis, insufficient management of at risk patients, late referral for specialist management and limited renal replacement therapy (RRT).[9 ,19,20] The asymptomatic nature of early stages of kidney damage also means that kidney damage remains undetected until late, when therapeutic interventions may be ineffective.[22] The above mentioned reasons are true to the health system of Botswana, where if at all screening is done, it is only based on either serum creatinine levels or the presence of albuminuria , which is not recommended for screening. [8, 11, 23, 24]

General observation in Botswana has identified that CKD among patients with diabetes is on the rise, and that the majority of patients attending dialysis at the Renal Care Institute Botswana are also diabetic. In Botswana, there is no current published research on the prevalence of CKD in adult patients with T2DM.This research further seeks to assist with the implementation of appropriate routine screening for CKD in primary care, as treatment options for ESRD are not readily available in Botswana; and based on personal observation, this is probably due to lack of appreciation of the burden of and the expense of managing CKD.

Aim

To determine the prevalence of CKD and associated factors among the adult patients with T2DM who attend the Diabetes Centre in Gaborone, Botswana.

Objectives

1. To determine the prevalence of CKD and the different stages of disease progression amongst adult diabetic patients, using serum creatinine values and calculating the eGFR.
2. To identify the socio-demographic and clinical (risk) factors associated with CKD in this setting.
3. To audit and evaluate the current management of CKD in this population, according to local (SEMDSA) and international (NKF-KDOQI) guidelines.

Methods

Study Design

The study was a clinic based descriptive cross sectional survey.

Setting

The diabetes center of excellence is an outpatient diabetes clinic in Gaborone, the capital city of Botswana. This specialized diabetes center was an initiative from the Ministry of Health aimed at standardizing the care and

management of diabetes and its related complications in all patients with diabetes in Botswana. The aim of this initiative was to reduce the number of debilitating complications associated with poorly controlled diabetes which include cardiovascular disease, blindness, renal failure, nerve damage, amputations, etc., all of which reduce quality of life and impose significant financial burden on the health system.

This center caters for diabetic patients in Gaborone and catchment areas with an average of about a thousand consultations per month. This center offers diverse services aimed at managing glycemic control offered by a multidisciplinary team. This team includes a family physician, two medical officers, an endocrinologist, clinical dietitian, specialist diabetes nurse educator and, specialist ophthalmology nurses.

The services offered at this center include medical consultations with routine monitoring and individualized management of diabetes .In addition, structured diabetes education programs for T2DM foot care and cardiovascular risk reduction sessions are offered weekly. There is an onsite clinical dietitian who offers expert advice on nutrition and healthy lifestyle. Other services such as retinal screening are provided by specialist ophthalmology nurses with the aim to prevent blindness from early detection and management of eye complications. Foot screening is conducted for early detection of complications of blood and nerve supply to the feet which increases risk for injury, non healing wounds and ultimately amputations.

Phlebotomy services are offered onsite and routine blood tests used in monitoring of diabetes are conducted at an onsite laboratory. Pharmaceutical services are offered by trained pharmacists who provide expert advice on medication use, safety and storage.

Sampling procedure

A total of 408 patients were consecutively sampled over a period of six months. Patients who presented to the clinic for follow up, at the time of data collection and who met the inclusion criteria and agreed to participate in the study were included. The sample size was based on an estimated prevalence of 33% percent as presented in the literature review. A sample size of ***340*** was able to estimate the population prevalence to within 5%, using a 95% confidence interval. To accommodate a loss of about 20% (due to incomplete or inaccurate data) the sample size was increased to 408.Statistical significance was defined as p =<0.05.

Study Population

Inclusion criteria

- Men and women 18 years and above with T2DM being followed up at the Diabetes Center in Gaborone.
- Patients who have had their serum creatinine level checked at least once in the last 12 months.

Exclusion criteria

- Patients with Type 1 diabetes Mellitus.

- Patients who are being seen for the first time at the clinic.

Data collection

A standardized data extraction form (questionnaire) was used to capture socio-demographic and clinical characteristics of the participants. Serum creatinine, urine albumin levels and HbA1c were retrieved from the patient's lab results, which are usually stored in a digital format (Integrated Patient Medical record System). Patients' files were reviewed for blood pressure and glycemic control as well as antidiabetic and or antihypertensive medication use.

Data collection tool

A standardized data extraction form was used for data collection. Socio- demographic information included; gender, age, marital status, level of education, weight and height for Body Mass Index (BMI) calculation, smoking history and alcohol intake. Clinical parameters included: serum creatinine levels, HbA1c, urine albumin creatinine , duration of diabetes, established complications of diabetes in particular diabetic retinopathy (with recent visual acuity results), presence or absence of hypertension, medications and at least two consecutive readings of blood pressure, blood sugar level and urine dipstick results (see appendix 2). This data extraction questionnaire, (see appendix 2) was completed by the person collecting the data.

Data Analysis

The primary outcome was the prevalence and associated factors of CKD within the study population. Data was entered in Microsoft Excell and analyzed using SPSS 10. Descriptive statistics for the clinical subgroups and CKD specific subgroups were calculated. For the continuous variables mean, standard deviations were calculated by subgroups and overall. For categorical variables, frequencies and proportions were calculated by subgroups and overall. Logistic regression analysis model was used to model the outcome CKD on age, BMI and duration adjusted for socioeconomic factors education, smoking, alcohol use and gender. The prevalence of CKD was estimated for the overall sample and 95% confidence intervals were calculated using the binomial distribution Chi-square test was used for the comparison of proportions of subgroups. To select variables that were strongly associated with CKD, back selection procedure was used where all variables were included in the regression model and variables that were not significant at each step dropped from the model. .Odds ratios and 95% confidence intervals were reported. We concluded that there is significance if $p=<0.05$.

Definitions

The NKF [1] defines CKD by the persistence of a low GFR and or albuminuria during a period of at least three months. In our study we determined point prevalence as eGFR less than 60ml/min with or without albuminuria or any reduced eGFR (but more than 60ml/min) in the presence of albuminuria. The eGFR was calculated using the Cockcroft Gault formula. CKD stages were defined according to the NKF classification; CKD1 eGFR > 90 ml/min and

albuminuria, CKD 2 60-89 mil/min and albuminuria, CKD 3 30-59ml/min, CKD 4 15-29 ml/min and CKD 5 <15ml/min or dialysis.

Previous diagnosis of CKD was defined as a documentation of any CKD stage prior to the study period and enrollment.

Patients

A total of 408 patients were enrolled into the study from November 2015 until April 2016. Patients were interviewed for the socio-demographic information. Clinical parameters were then collected from their medical records; height and weight for BMI, serum creatinine levels, HbA1C, duration of diabetes and established complications of diabetes, presence or absence of hypertension, medications and three consecutive readings of blood pressure and blood sugar level results.

A pilot study was conducted and during this period we identified that the clinic did not routinely check for albuminuria in all T2DM patients, so from then on patients who agreed to participate in the study had to produce a urine sample for ACR determination. In the original data collection sheet, one of the criteria was to check for ACEI/ARB use in combination with a diuretic. This strict criterion excluded patients who were on ACEI/ARB monotherapy and so the importance of Renin Angiotensin Aldosterone System (RAAS) inhibition in treatment was therefore lost, this we later changed to the use ACEI/ARB as monotherapy or in combination with other drugs.

Ethical Considerations

To ensure fair selection, only those patients capable of giving informed consent were included in the study. Participants were expected to give written consent to be included in the study. Participation in the study was on a voluntary basis, and those wishing to withdraw could do so at any time. A brief written summary of the aims of the research, the nature of the data to be collected was given to the participants in both English and Setswana. For those who were illiterate, the same information was relayed to them in Setswana. This research did not involve any intervention so the risk of harm was negligible. Data collected was kept confidential by way of coding i.e. every completed data extraction sheet was given a code in order to de-identify the participant from whom it was collected. No information that may identify the patient was collected. Ethics approval was sought from both the Health Research Ethics Committee (HREC) at Stellenbosch University and the Botswana Health Profession's Ethics committee.

Results

A total of 408 participants were included in the study. The average age of the participants included in the analysis (n=408) was 57.1 (SD 11.3) years. There were 65.9% females (n=269).Table 1 shows baseline characteristics of all patients and by CKD status. In comparing the CKD group and the non CKD group, there was a significant difference($p<0.05$) between the two groups in terms of age, diabetic duration ,BMI, systolic BP, glycemic control and education level .

Table 1: Baseline Characteristics

	All Participants	**By CKD Status**		
Baseline Characteristics	n=408	No CKD (n=149)	CKD (n=259)	P
Age (in years)[1]	57.1 (11.3)	54.8 (10.1)	58.5 (11.7)	0.001
Diabetic Duration (in years)[1]	7.7 (7.1)	6.1 (6.0)	8.6 (7.6)	0.001
BMI[1]	30.9 (6.5)	32.3 (6.0)	30.1 (6.6)	0.001
Average SBP (mmHg)[1]	135.7 (15.0)	133.3 (13.7)	137.1 (15.6)	0.016
Average DBP (mmHg)[1]	80.0 (9.4)	80.1 (9.2)	79.4 (9.6)	0.489
AHGT[1]	9.2 (3.3)	8.5 (2.8)	9.5 (3.5)	0.003
HBA1C[1]	7.7 (1.8)	7.4 (1.5)	7.9 (1.9)	0.004
Gender				0.358
Male	34.1%	36.9%	32.4%	
Female	65.9%	63.1%	67.6%	
Marital Status				0.629
Single	36.8%	40.3%	34.7%	
Married	49.5%	47.7%	50.6%	
Widowed	11.3%	9.4%	12.4%	

Divorced	2.5%	2.7%	2.3%	
Education				0.014
None	16.4%	14.8%	17.4%	
Primary	50.0%	43.6%	53.7%	
High School	22.3%	24.2%	21.2%	
Tertiary	11.3%	17.4%	7.7%	
Smoking				0.655
Yes	6.9%	6.0%	7.3%	
Ex Smoker	22.5%	24.8%	21.2%	
Never	70.6%	69.1%	71.4%	
Alcohol				0.404
Yes	6.6%	8.7%	5.4%	
Previous Intake	31.9%	32.2%	31.7%	
Never	61.5%	59.1%	62.9%	
BMI				0.014
Normal	15.0%	8.8%	18.5%	
Overweight	33.4%	30.4%	35.1%	
Obese	44.2%	51.4%	40.2%	
Morbidity Obese	7.4%	9.5%	6.2%	
Hypertension				0.125
No	29.7%	34.2%	27.0%	
Yes	70.3%	65.8%	73.0%	

[1]Mean (Standard deviation) and the t-statistics was used to compute the p-value (P).

Associated factors

Associated variables from the descriptive analysis were then subjected to multivariate analysis .Table 2 below shows variables that were significantly associated with with CKD, including hypertension which was only marginally associated with CKD.

Table 3: Adjusted odds ratios from logistic regression for variables significantly associated with CKD including Hypertension

	Adjusted Model	
Baseline Characteristics	**OR (95% CI)**	**P**
Diabetic Duration (in years)	1.06 (1.02, 1.10)	0.001
HBA1C	1.20 (1.05, 1.36)	0.009
Education		0.036
None	1	
Primary	1.00 (0.53, 1.89)	
High School	0.74 (0.36, 1.52)	
Tertiary	0.37 (0.16, 0.85)	
BMI		0.020
Normal	1	

	Overweight	0.55 (0.27, 1.16)	
	Obese	0.35 (0.17, 0.71)	
	Morbidity Obese	0.35 (0.13, 0.95)	
Hypertension			0.051
	No	1	
	Yes	1.61 (1.00, 2.60)	

OR=1for the reference category and the reported p-value for categorical variables with more than two categories is the likelihood ratio p-value. All other p-values are based on the Wald statistic.

Prevalence of CKD

The prevalence of CKD was 63.5% (95% CI: 58.7% to 68%, n=259). Overall albuminuria was observed in 62.59% (n=251)of the study population; 61%(n=241) showed evidence of microalbuminuria while 2.45%(n=10) had macroalbuminuria. Overt proteinuria was observed in 9.18%(n=37) of the patients. Table 2 shows the the frequency of the different CKD stages.

Table 3: Frequency of different CKD stages

CKD stage	Frequency	Percent	Cumulative %
1	138	53.3	53.3
2	77	29.7	83.00
3	36	13.90	97.09
4	6	2.32	99.42
5	2	0.77	100.00
Total	259	100	

Table 4 below shows mean values of blood pressure and glycemic control, average ACR, electrolyte , hematologic and lipid profile of the CKD population.

Table 4: Mean values of selected clinical and laboratory screening data of the CKD group

Variable	Mean	SD
SBP (mmHg)	137.	16
DBP (mmHg)	79.	10
Average HGT (mmol/L)	9.5	3.5
HbA1c (%)	7.9	1.9
ACR (mg/mmol)	8.9	15.7
Creatinine (µmol/L)	83.4	57.
Hemoglobin	13.2	1.8
Urea(mmol/L)	5.5	3.3
Sodium(mmol/L)	135	17.
Potassium(mmol/L)	6.7	16.1
Chloride(mmol/L)	100.6	5.5
eGFR(mL/min)	103.8	49.4
Cholesterol(mmo/L)	4.6	1.0
HDL(mmol/L)	1.2	0.5
LDL (mmol/L)	3.2	6.1

Awareness of CKD

Overall CKD status was documented in 6.6 %(n=17) of the total CKD group. Table 4 below shows documentation of CKD status overall and by CKD staging.

Table 5: Documentation and awareness of CKD

CKD Stage	Documentation of CKD status		
	Yes	No	Total
1	0 (0%)	138 (100%)	138
2	5 (6.49%)	72 (93.51%)	77
3	4 (11.11%)	32 (88.89%)	36
4	6 (100%)	0 (0%)	6
5	2 (100%)	0 (0%)	2
Total	17 (6.56%)	242 (93.44%)	259

Antihypertensive medication

Of all the participants, 57.8 %(n=236) were on two or more antihypertensive agents. See figure 1 and 2.

Figure 1 shows percentage number of all patients in the study population being treated with lifestyle modification (no drug),single or multiple drug combinations.

Figure 1: Antihypertensive profile of study population

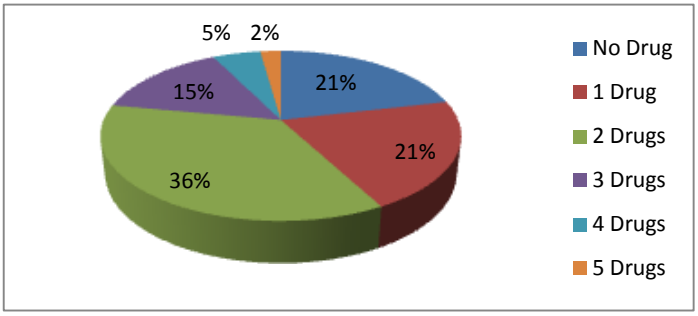
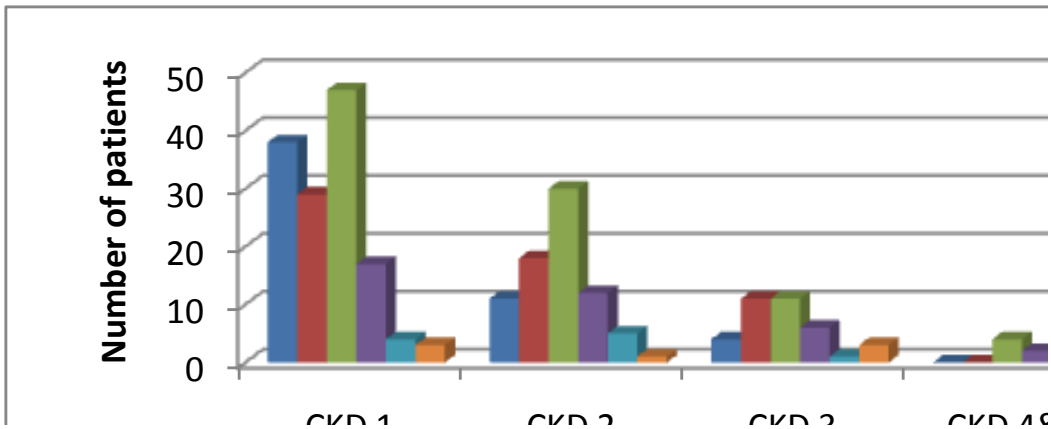


Figure 2 below shows the number of patients treated with lifestyle modification (no drug) or antihypertensives either as monotherapy or as combinations according the CKD stage.

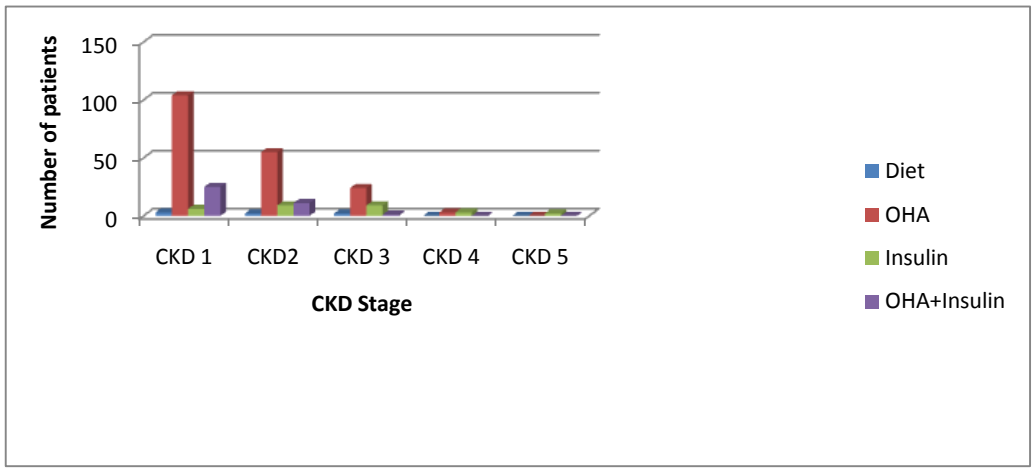
Figure 2: Antihypertensive agent profile according to CKD stage



Anti-diabetic medication

Figure 3 shows the number of patients being treated with either diet or different antidiabetic agents according to the CKD stage. Only 2.7 %(n=7) were on diet control alone while rest were either on an oral hypoglycemic agent or insulin or a combination of both.

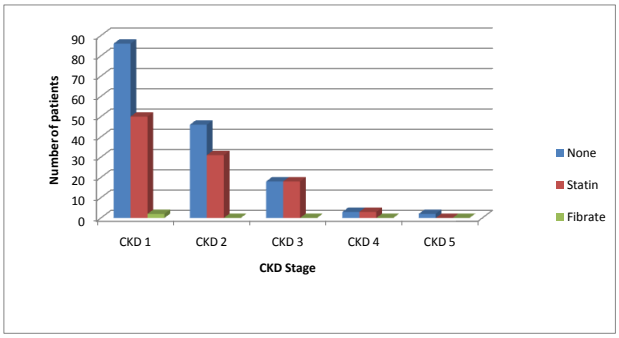
Figure 3: Antidiabetic medication profile according to CKD stage



Cholesterol medication

A total of 40.2 % (n=104) patients with CKD were on any form of lipid lowering drug. Figure 4 shows the number of patients with CKD who had a diet (none)/ statin/fibrate for lipid control according to the CKD stage..

Figure 4: Cholesterol medication profile according to CKD Stage



Diabetic Complications

The presence of observed retinopathy was higher in the CKD group vs. the non CKD group (p=0.043). There was no statistically significant difference in terms of the rest of the complications between the CKD and non CKD group. Table 5 shows percentage number of patients with diabetic complications in the study population overall and in the CKD group specifically.

Table 6: Diabetic complications within the CKD and non CKD group

Diabetic Complication	All participants	B y CKD Status		P
	%(n=408)	No CKD :%(n=149)	CKD %(n=259)	
Retinopathy	16.18	11.33	18.99	0.04
Cataracts	8.82	8.00	9.30	0.65
Neuropathy	32.11	34.00	31.00	0.53

Diabetic Foot	0.98	0.02	0.38	0.11

Target HbA1c

Target HbA1C of <7% was achieved in 38.2 %(n=99) of the CKD population with poor control being observed in the earlier stages of CKD; 66.6% (n=92) in CKD 1 and 64.9 % (n=50) in CKD 2 respectively.

Target Blood pressure

Target blood pressure control was observed in 20.9% (n=54) of the CKD population. 50% (3) patients with CKD 4 and 100%(2) in CKD 5 had met target blood pressure control. See table 6 below

Use of ACEI/ARB in blood pressure control

Overall 52.5% (n=136) of the CKD group had ACEI/ ARB included in the management of blood pressure either as mono therapy or combined with agents from other antihypertensive classes.

Use of ACEI/ARB if microalbuminuria and normal blood pressure

A total of 20.3% (n=28) of patients with CKD 1 had normal blood pressure and microalbuminuria but were not on an ACEI/ ARB compared to 7.8% (n=6) in CKD 2 and 5.6% (n=2) in CKD 3.

LDL>100 mg/dL +statin

A total of 40.9 % (n=106) of all patients with LDL>100 mg/dL were started on lipid lowering agents. 29.7% (n=77) of the audit group was already on treatment, leaving 28.9% (n=75) who were over the target and yet were not started on lipid lowering agents.

Protein restriction

Protein restriction was prescribed in all patients with CKD 4 and 5 (n=8).None of the patients with CKD stage 1 were on a protein restricted diet, followed by 3.9 %(n=3) in CKD 2 and 27.8 %(n=10) in CKD 3.

Target BMI

Target BMI was achieved only in 19.3% (n=50) of the audit group. All in CKD 5 (n=2) had a target BMI of ≤24.5 kg/m² compared to 33.3% (n= 2) and 44.4% (n=16) in CKD stages 4 and 3 respectively. The least BMI targets were

observed in CKD 1 and 2 at 8.0 % (n=11) and 24.7% (n=19) respectively. Table 6 below shows clinic performance on the seven quality outcomes applied to the CKD group.

Table 7: Audited quality outcomes and clinic performance

Target	Percentage Achieved (%) N=259
HbA1c< 7	38.2
Blood pressure <130/80	20.9
ACEI/ARB + other	52.5
ACEI/ARB in Normal BP	14.0
LDL>100 + statin	40.9
Protein Restriction	8.1
Target BMI ≤ 24.5	19.3

Discussion

The prevalence of CKD among adult patients with T2DM as defined by GFR < 60 mL/min per 1.73m² or ACR > 30mg/g was found to be 63.5 % (95 % CI: 58.7%-68%), much higher than the reported range of 38.3% [25] in developed countries and lower than 83.7% reported in Tanzania. [9] The Majority of participants were classified as CKD stages 1 and 2 (53.3% and 29.7 % respectively) refer to table 3 .The higher prevalence in our study might be explained by the fact that the majority of the participants were much older and we used an age dependent eGFR formula. It may also reflect some degree of referral bias as the study was conducted in a clinic that specializes in managing diabetes and hypertensive disorders or even reflect the increasing burden of T2DM within our society. This high prevalence of CKD raises a significant public health concern in that it may signal the rise of ESRD. A high prevalence of CKD underlines the need to actively screen patients for CKD and intervene to slow disease progression.

Previous diagnosis of CKD (defined as documentation of CKD status in the patient's file) was observed only in 6.56% of the CKD group as shown in table 5, so the majority of patients were diagnosed during the study itself. This could be explained by the use of creatinine levels in estimating eGFR which has been found to underestimate CKD as creatinine levels only show evidence of disease in advanced stages. As shown in table 4, the average creatinine level for the CKD was well within the normal range (83 umol/L, SD 17). This study confirms the need to calculate GFR as opposed to using rising creatinine level as a marker for declining renal function.

Current literature suggests demographic and clinical risk factors associated with development and progression of CKD. Older age and male gender are among the demographic risk factors observed in previous literature. In our study male gender was not observed as a risk factor for CKD probably because 65.93% of participants were female (see table 1). There was a linear association between age and CKD with higher rates of CKD being observed in

much older participants and generally participants with CKD were older by 4 year(n= 255). (p= <0.05) however after adjusting for other factors, age was not considered a risk factor (p=0.19) Although an association between smoking and CKD has been well described, in this study smoking history did not show any difference between the two groups (p=0.65).Low socioeconomic status has been reported as a risk factor for CKD in multiple studies before; in this study we also observed lower prevalence rates in those with a higher education(p=0.036). Longer duration of diabetes was a significant risk factor for CKD; with a 7 % increase in odds for every year since diagnosis (OR 1.06 [95% CI: 1.02-1.1], p=0.001). This once again highlights the need to start screening patients for CKD from the point of diagnosis. BMI showed a nonlinear association with lower prevalence of CKD being observed in the 30-40 BMI range. Participants with low BMI had the highest prevalence possibly because there was more emphasis on reaching the target weight; however; numerous studies indicate that a high BMI is associated with adverse outcomes in the general population primarily because of increased risk of cardiovascular disease. A large population based study from Israel showed a positive correlation between BMI and CKD[26] and this has been supported by other studies.[27] In our study we identified an inverse association between BMI and CKD, with higher prevalence rates of CKD being observed in patients with a lower BMI .This association has also been observed in other studies [28,29] which concluded that BMI values in the overweight range were protective in terms of renal outcomes and all cause mortality in patients with CKD. This finding calls for more research to further inform of possible reasons for this observation. There is also the need to institute cautious weight management guidelines in this group of patients to balance both the benefits and deleterious effects of extremes of BMIs. For a low income country like Botswana, there is evidence of increasing obesity rates due to poor dietary choices and lack of physical activity, so population based health initiatives should continue to address obesity as a risk factor for CKD. Health interventions that focus on obesity ought to be intensified as obesity has been shown to have deleterious effects. BMI as a measure of obesity does not discriminate between adiposity and higher muscle mass, perhaps other measures of obesity like waist hip ratio should be used instead.

There was no significant difference in both systolic and diastolic blood pressures between the CKD and non CKD group after adjusting for other factors (p=0.052). Hypertension can both be a cause for and a result of CKD. The lack of difference in blood pressure control between the two groups could indicate inadequate control among patients without CKD, which is concerning given the high prevalence of CKD. Glycemic control was statistically different between the CKD and non CKD group in terms of HbA1C (p=0.009). In terms of diabetic complications, there was no significant difference in both groups with regards to the presence of cataracts (p=0.65), neuropathy (p=0.53), and diabetic foot (p=0.11) respectively; however, retinopathy was significantly higher in the CKD group as opposed to the non CKD group (p=0.04)., refer to table 5.This is an expected outcome which emphasizes the need concurrently screen patients for retinopathy.

Current guidelines suggest target HbA1c and blood pressure control, both of which were not met, refer to table 6. Although guidelines have moved away from the more stringent HbA1c< 7% due to increased mortality from severe hypoglycemia, it still remains imperative to optimize the management of risk factors among those with T2DM.In this study we observed better target rates in CKD stages 4 and 5 compared to lower CKD stages. This may indicate that the patients were being followed up at specialist clinics where there was more emphasis on achieving target glycemic control, that insulin requirements decrease with worsening renal function and could also explain why higher rates for target BMI and protein restriction (100% respectively in CKD 4 and 5 vs 19.3%and 8.1% respectively in the overall CKD group) were also observed in later stages of CKD.

Even though the importance of Renin Angiotensin- Aldosterone System (RAAS) inhibitors is widely recognized in this group of patients, an ACEI/ARB was used in 52.5% of patients with hypertension and only 14.0% of those with normal blood pressure and microalbuminuria. The SEMDSA and NKF KIDQOI guidelines suggest starting an ACEI/ARB in patients with normal blood pressure and albuminuria as it has been linked to cardiovascular complications. Although ACE-I/ ARB's have been shown to delay disease progression, consideration should also be given to worsening renal function as evidenced by rising creatinine levels or development of hyperkalemia. In our study, the results indicated a slight elevation in potassium levels of 6.7mmol/L (table 3), which was incidental as this was not documented as a reason for not starting ACEI/ARB in patients who could benefit from such an intervention. Management of LDL levels more than 100mg/dL has also been emphasized. In our study only 40.9% of patients with elevated LDL levels were on treatment. This low rate could be explained by the fact that screening patients for cardiovascular risk factors was inadequate. Apart from CKD and micro or macro albuminuria, SEMDSA guidelines suggest starting statin therapy for all patients with T2DM who: have an existing cardiovascular disease, are older than 40 years or longer duration of diabetes of more than ten years with additional cardiovascular risk factors like hypertension, active smoking, low HDL levels and family history of early coronary heart disease. This finding is of concern given that the average age of the study population is much older at 57 years (see table 1), with an average Blood pressure of 136/80mmHg. This calls for more attention to the management of cardiovascular risk factors in patients with T2DM and even more aggressively in patients with CKD.
Overall poor performance indicators could be due to reliance on creatinine levels to diagnose CKD so in the process the majority of patients are not diagnosed until later stages which makes it difficult to apply targets when routine screening with albuminuria and GFR estimation is not done.

Limitations

This study was a cross sectional study at a clinic specializing in the management of diabetic and hypertensive disorders, therefore the results may not apply to general practitioner run clinics limiting generalizability. Furthermore, the study lacked direct GFR measurements and relied on estimation of GFR using the Cockcroft Gault

equation which has been shown to be less accurate in older and obese individuals. [30] Single spot urine sample was used for the measurement of microalbuminuria and since transient increases in urine albumin is well described in certain states like ketosis, hyperglycemia, and urinary tract infection [1]; it is quite possible that there may have been an overestimate of CKD. Moreover, the single measurement of GFR did not distinguish between persistent alteration in renal clearance and transient states.

Conclusion

The prevalence of CKD among adult patients with T2DM was 63.5 %, a large proportion of which was CKD stages 1 and 2. Associated socio demographic and clinical risk factors included longer duration of diabetes, education level, BMI, poor glycemic control and the presence of retinopathy. Management of CKD according to SEMDSA and NKF guidelines was generally poor as most patients were diagnosed with CKD during the study period; documented CKD status was observed only in 6.6% of the CKD population.

This research has highlighted the need to screen patients for CKD with both the ACR and eGFR to avoid under diagnosis and under treatment of earlier stages of CKD. Determination of ACR was not routinely undertaken, as a result aggressive management of cardiovascular risk factors was found to be lacking which emphasizes the need screen patients for the presence of microalbuminuria on a regular basis. The importance of RAAS inhibition in patients with microalbuminuria has been well described, in this study only a small proportion of patients with microalbuminuria were on either ACEI/ARB due to lack of routine ACR measurement; this once again calls attention to routine screening for microalbuminuria. There is a need to consistently document the CKD stage of all patients in order to trigger stage appropriate monitoring and treatment and to extend screening and management of cardiovascular risk factors to all patients with T2DM, even in the absence of CKD.

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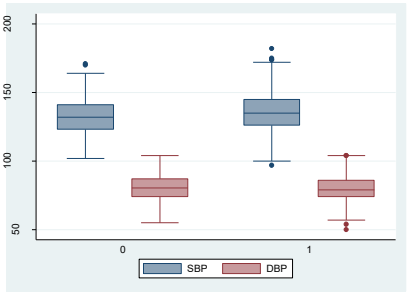
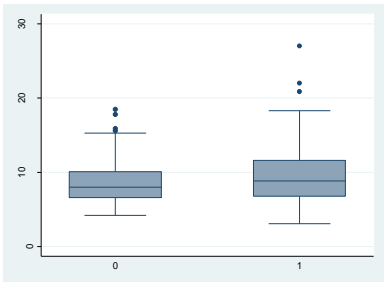
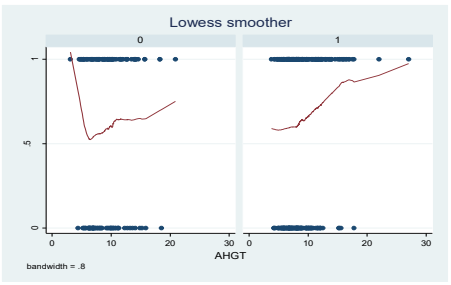
Appendix 1

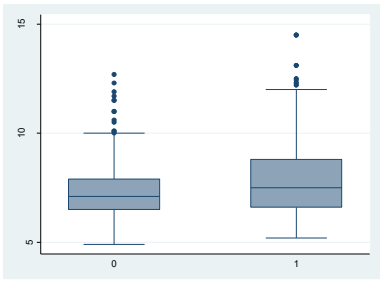


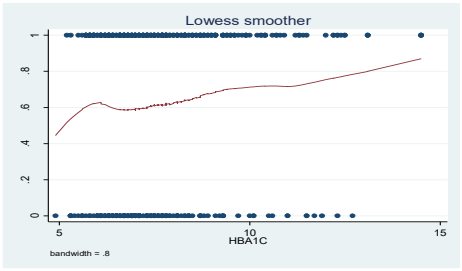
Blood pressure control between CKD and non CKD group





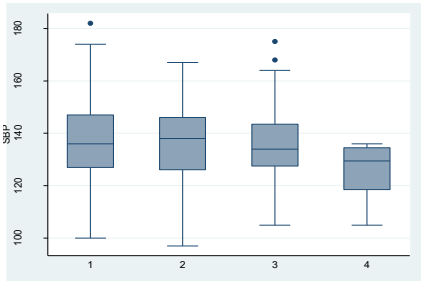
Average HGT results of CKD and non CKD group

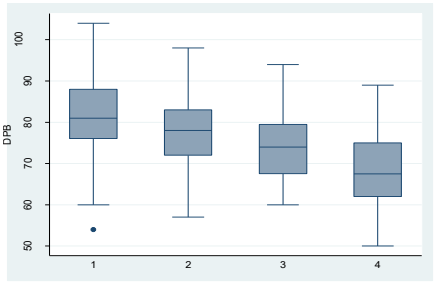




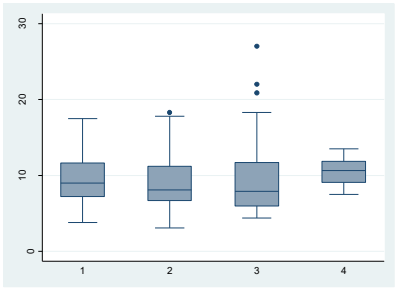
HbA1c profile of CKD and non CKD group

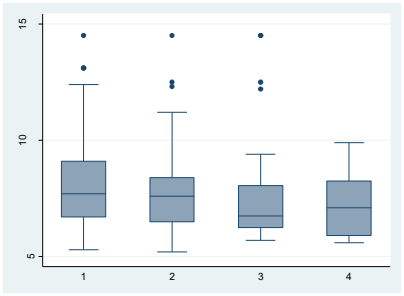
Audit parameters- CKD group only



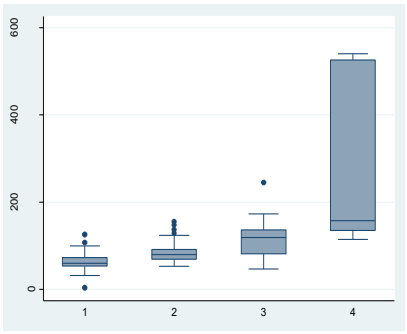


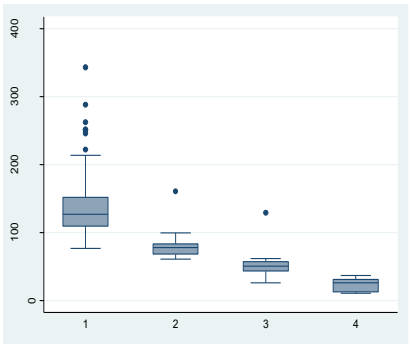
Systolic abd diastolic blood pressures according to CKD stage



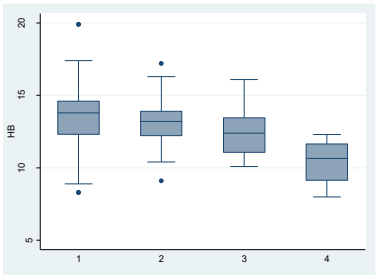


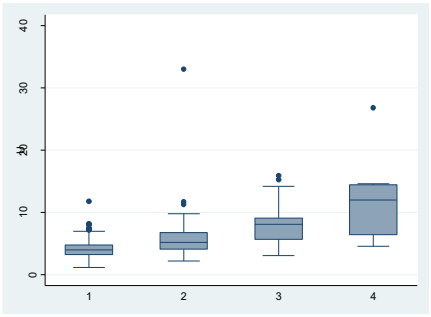
Average hemoglucotest and HbA1c according to CKD stage



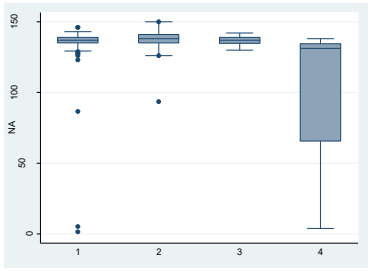


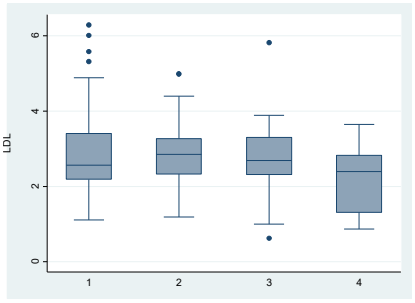
Creatinine levels and eGFR levela according to CKD stage





Hemoglobin and urea levels according to CKD stage





Sodium and LDL levels according to CKD

PARTICIPANT INFORMATION LEAFLET / CONSENT

The study has been approved by the Health Research Ethics Committee of Stellenbosch University, South Africa and will determine the prevalence of Chronic Kidney Disease (CKD) among adult patients with Type 2 Diabetes Mellitus (T2DM) who attend the Diabetes Centre in Gaborone, Botswana.

TITLE OF THE RESEARCH PROJECT:
The prevalence of Chronic Kidney Disease (CKD) among adult patients with Type 2 Diabetes Mellitus (T2DM) who attend the Diabetes Centre in Gaborone, Botswana.

REFERENCE NUMBERS: SU15/01/001 (HPDME 13/18/1 IX (527))

PRINCIPAL INVESTIGATOR: DR N. RADIKARA

ADDRESS: P. O. BOX 3608, GABORONE, BOTSWANA

CONTACT NUMBER: +267 75 544 411

You are being invited to take part in a research project. Please take some time to read the information presented here, which will explain the details of this project. Please ask the study staff or doctor any questions about any part of this project that you do not fully understand. It is very important that you are fully satisfied that you clearly understand what this research entails and how you could be involved. Also, your participation is **entirely voluntary** and you are free to decline to participate. If you say no, this will not affect you negatively in any way whatsoever. You are also free to withdraw from the study at any point, even if you do agree to take part.

This study has been approved by the **Health Research Ethics Committee at Stellenbosch University** and the **Ministry of Health HRDC** and will be conducted according to the ethical guidelines and principles of the international Declaration of Helsinki, South African Guidelines for Good Clinical Practice and the Medical Research Council (MRC) Ethical Guidelines for Research.

What is this research study all about?

This research aims to determine how many patients with type 2 diabetes have developed Chronic Kidney disease (damage to the kidneys that happens over time and can be a direct effect of poorly controlled diabetes or even high blood pressure). This will then help us determine the burden of Chronic Kidney disease among adults with type 2 diabetes. This research will also help us understand how best we can assist patients with type 2 diabetes with regards to what preventive measures can be taken, especially for those patients who are attended to at clinics that are not specialized for the management of diabetes. If you agree to participate, you will be asked some personal question (age, sex, marital status, level of education, smoking and alcohol habits) as well as questions about your condition (diabetes) and your outpatient card will be checked for your lab results (urine and

blood results), eye check results and the medication you are taking. Your weight and height will also be checked.

Why have you been invited to participate?

You have been invited to participate because the research is targeted at individuals with Type 2 Diabetes who are being followed up at this clinic (Diabetes Centre, Gaborone).

What will your responsibilities be?

Upon agreeing to participate, your responsibility will be to answer some questions and get your weight and height checked. The study staff or doctor will then review your card and lab results. If the lab results are not available, you may have to provide a urine/blood sample to the lab for analysis. This process should take a maximum of 20 minutes.

Who will have access to your medical records?

Only the study staff will have access to your medical records. Following the interview, your information card will be given a code so that no one can identify that the information was collected from you. Also, information collected from you will be kept confidential and protected. Other than the study stuff, individuals that may have access to the research information include research monitors or auditors as well as Research Ethics Committee members, however, please be informed that your confidentiality will be maintained throughout.

Will you be paid to take part in this study and are there any costs involved?

It is not expected that you will incur any costs when participating in the study as the interviews will take place at the time you come to the clinic to be seen by your doctor, you will therefore not be paid for your participation in the study. Your participation in the study will however be of benefit to you and other patients in that the knowledge we will gain from this research will help us better manage patients with Type 2 Diabetes who are at risk of developing Chronic Kidney Disease.

Is there anything else that you should know or do?

- You can contact Dr Radikara at tel +267 755 444 11 if you have any further queries or encounter any problems.

- You can also contact the Stellenbosch Health Research Ethics Committee at 021-938 9207 or the Botswana Health Research and Development Committee at (+267) 393 2751 if you have any concerns or complaints that have not been adequately addressed by your study doctor.

CONSENT TO PARTICIPATE IN THE RESEARCH STUDY

Declaration by participant

By signing below, I …… agree to take part in a research study entitled *The prevalence of Chronic Kidney Disease (CKD) among adult patients with Type 2 Diabetes Mellitus (T2DM) who attend the Diabetes Centre in Gaborone, Botswana.*

I declare that:

- I have read or had read to me this information and consent form and it is written in a language with which I am fluent and comfortable.
- I have had a chance to ask questions and all my questions have been adequately answered.
- I understand that taking part in this study is **voluntary** and I have not been pressurised to take part.
- I may choose to leave the study at any time and will not be penalised or prejudiced in any way.
- I may be asked to leave the study before it has finished, if the study doctor or researcher feels it is in my best interests, or if I do not follow the study plan, as agreed to.

Signed at (*place*) ..... on (*date*) …….. 20.....

....

Signature of participant **Signature of witness**

Declaration by investigator

I *(name)* …… declare that:

- I explained the information in this document to ……..
- I encouraged him/her to ask questions and took adequate time to answer them.
- I am satisfied that he/she adequately understands all aspects of the research, as discussed above
- I did not use an interpreter.

Signed at (*place*) ..... on (*date*) …….. 20.....

....

Signature of investigator **Signature of witness**

PAMPITSHANA YA KITSISO/NETEFATSO YA MOTSAAKAROLO

Patlisiso e e rebotswe ke komiti ya ditsamaiso tsa dipatlisiso tsa botsogo ya Stellenbosch University , South Africa mme e tla batlisisa gore ke balwetse ba le kafe,ba ba nang le bolwetse ba diphilo mo balwetseng botlhe e le bagolo ba ba lwalang bolwetsi ba sukiri ba ba tsayang kalafi ko Diabetes Center mo Gaborone.

SETLHOGO SA PATLISISO:

The prevalence of CKD among adults patients with T2DM who attend the diabetes centre in Gaborone, Botswana (Ke balwetse ba le kafe ba ba nang le bolwetsi ba diphilo mo balwetseng botlhe e le bagolo ba ba lwalwang bolwetse ba sukiri ba ba tsayang kalafi ko Diabetes Centre mo Gaborone).

NOMORO YA PATLISISO: SU15/01/001 (HPDME 13/18/1 IX (527))

MOTLHOTLHOMISI MOGOLO: DR N. RADIKARA

ATERESE: P. O. BOX 3608, GABORONE, BOTSWANA

MOGALA : +267 75 544 411

O lalediwa go tsaya karolo mo patlisisong. Tswee tswee tsaya sebaka go bala mokwalo kitsiso o, o tlhalosa dintlha ka patlisiso e. O ka botsa batlisisi kgotsa motlhotlhomisi wa ngaka ka karolo epe fela ya patlisiso e ka se o sa se tlhaloganyeng. Go botlhokwa gore o tlhomamise fa a tlhaloganya ka botlalo gore go tla abo go diragalang mo patlisisong e le gore seabe sa gago e tla abo e le eng fa o ka tsaya tshwetso ya go tsaya karolo. Go tsaya karolo go dirwa ka boitlhaopo, ka jalo o gololesegile go sa dumalane le go tsaya karolo. Fa o sa eletse go tsaya karolo ga gona go go rontsha epe tshwanelo ya gago ya botsogo. Le ntswa o ka dumala go tsaya karolo, o ntse o gololosegile go ka boela morago tshwetso ya gago fa patlisiso e ntse e tsweletse.

Patlisiso e e rebotswe ke Komiti ya Tshekatsheko ya Ditsamaiso tsa Dipatlisiso tsa Botsogo ya Stellenbosch University le ba Lephata la Botsogo, mme ebile e tla abo e tsamaisiwa ka ditsetlana le ditsamaiso tsa Declaration of Helsinki, Tsamaiso e e Lolameng ya tsa Botsogo ya Afrika Borwa le ditsetlana tsa Medical Research Council tsa Tsamaiso ya Dipatlisiso ka Mokgwa o Lolameng.

Maikaelelo magolo a patlisiso e ke eng?

Patlisiso e e sekaseka gore ke balwetse ba le kae ba ba lwetseng sukiri e le bagolo ba e leng gore ba feletse ba lwala diphilo (go koafala ga diphilo go tsaya lobaka go diragala mme go ka tsalwa ke sukiri e e sa laolesegeng kgotsa madi a matona). Mo ga ka tla ga thusa go ka tlhaloganya bokete jwa bolwetse jwa diphilo mo bagolong ba ba lwalwang sukiri. Patlisiso e ka thusa gape ka metlhale ya go thusa balwetse ba sukiri go thibela go koafala ga diphilo bogolo jang mo dikokelong tse di senang boitseanape ja bo tseneletseng ja bolwetse jwa sukiri. Fa o ka dumalana le go tsaa karolo mo patlisisong e, o tlaa botswa dipotso ka ga gago (dingwaga, bong, a o mo nyalong, seemo sa gago sa thuto, go re a o goga motsokwe le go nwa bojalwa), dipotso ka seemo sa gago sa botsogo (boletswe ja sukiri), maduo a ditshekatsheko go tswa mo karateng ya gago ya kokelwana (jaaka maduo a motlhapo kgotsa madi a mmele), maduo a ditlhatlhobo tsa matlho le melemo e o e nwang. O tla kalwa bokete jwa mmele le go tlhomamisa boleele jwa gago.

Ke eng o lalediwago tsaa karolo?

O laledіwa ka ntlha ya gore tshekatsheko e e itebagantse le balwetse ba sukiri ba ba bonang thuso ya bone ya bongaka mo kokelwaneng e.

Seabe sa gago e tlaa nna eng?

Fa o setse o dumelanye le go tsaya karolo mo patlisisong, o tlaa kopiwa go araba dipotso le go kalwa bokete jwa mmele ga mmogo le go sekasekwa boleele jwa gago. Babatlisisi kgotsa ngaka ba tlaa sekaseka karata ya gago ya kokelo le maduo a ditlhatlhobo tsa gago tsa motlhapo le madi a mmele. Fa maduo a go nna jalo a seo o ka lopiwa go tsewa motlhapo le madi gore di tlhatlhojwe.

Ke mang yo o tla nnang le tletla ya go ka bona sepe sa maduo a gago a botsogo mo karateng ya kokelwana?

Badiri ba patlisiso e ke bone fela ba tla bonang maduo a gago a tsa botsogo. Morago ga potsolotso, sepe se se kwadilweng ka ga gago se tlaa bewa mo karateng e e kwadilweng nomoro gore go se nne ope yo o ka itseng gore mokwalo o tshotse dintlha ka wena. Godimo ga moo mokwalo ope ka wena o o dirisiwang mo patlisisong o tlaa tlhokomelwa o be o sirelediwa gore kitso ka wena e se bonwe ke ope yo o senang tetla.

A o tla atswiwa ka madi go tsaya karolo kgotsa a go tla go lopa tuelo nngwe go tsaya karolo mo patlisisong?

Ga go a solofelwa gore o tla nna le ditshenyegelo ka ntlha ya go tsaa karolo o mo patlisisong e,ka gore potsolotso e tlaa dirwa ka nako e o tla bong o tsile kokelwaneng go bonwa ke ngaka ya gago,ka jalo ga o na go duelelwa kgotsa go bona dikatso ka ntlha ya go tsaa karolo.Mme go tsaa karolo ga gago mo patlisisong e go tlaa thusa gore metlhale ya tlhokomelo ya balwetse ba ba lwalang sukuri e tokafale ka ntlha ya kitso e e tlaa anyiwang mo patlisisong e.Ka jalo, go tsaa karolo ga gago go tlaa thusa balwetse ba sukiri ka kakaretso ba ba mo seemong sa go ka koafala diphilo ka ntlha ya bolwetsi jwa sukiri, ga mmogo le wena.

A go nale sengwe sepe se sele se o tlhokang go se itse kgotsa go se dira?

O ka itshwaraganya le motlhotlhomisi mogolo Dr. N Radikara mo mogaleng wa (+267) 755 444 11 fa o na le dipotso kgotsa matshwenyego ape mabapi le tsamaiso ya patlisiso e.

O ka ikgolaganya gape le ba Komiti ya Tshekatsheko ya Ditsamaiso tsa Dipatlisiso tsa Botsogo mo mogaleng wa (+27) 21 938 9207 kana (+267) 3914467.

TUMALANO YA GO TSENELELA PATLISO/GO TSAYA SEABE MO PATLISISONG

Netefatso ya Motsaakarolo

Ka go baa sekano, ke le .....ke dumela go tsaa karolo mo patlisisong ya *The prevalence of CKD among adults patients with T2DM who attend the diabetes centre in Gaborone, Botswana*(Ke balwetse ba le kafe ba ba nang le bolwetse ba diphilo mo balwetseng botlhe e le bagolo ba ba lwalang bolwetse jwa sukuri ba ba tsayang kalafi koDiabetes Centre mo Gaborone).

Ke tshepisa gore:

- Ke badile kgotsa ke balwetswe dintlha ka tumalano e, le gore e kwadilwe ka puo e ke e tlhaloganyang ka botlalo.
- Ke nnile le tshono ya go botsa dipotso mme ka tlhalosetswa mo go tsotlhe tse ke neng ke sa di tlhaloganye.
- Ke tlhaloganya gore go tsaa karolo mo patlisisong e go dirwa ka boithaopo mme ebile ga ke a pateletswa go tsaa karolo.
- Ke ka kgona go boela morago tshwetso ya go tsaa karolo mo patlisisong e nako epe fela mme go dira jalo ga gona go nthontsha tshono epe ya ditshwanelo tsa botsogo.
- Ke ka nna ka kopiwa go tlogela go tsaa karolo mo patlisisong pele ga e ya motsubong fa e le gore ngaka ya patlisiso kgotsa motlhotlhomisi a akanya gore se ke sone se se siametseng botsogo jme kgotsa ke sa ele tlhoko melao ya patlisiso jaaka go dumalanwe.

Sekano ko (lefelo)..... mo letsatsing la .....20….

....
Sekano sa motsaakarolo **Sekano sa mosupi**

Netefatso ya Motlhotlhomisi

Ke le (leina)..... ke netefatsa gore

- Ke tlhalositse dintlha tsa mokwalo o go.....
- Ke mo rotloeditse go botsa dipotso mme ebile ke tsere nako go di araba.
- Ke kgotsofaletse gore o tlhalogantse dintlha tsotlhe ka patlisiso jaaka go setse go nankotswe fa godimo
- Ga ke a dirisa motoloki.

Sekano ko (*lefelo*) ..... mo letsatsing la .....20.....

....
Sekano sa motlhotlhomisi **Sekano sa mosupi**

Appendix 2

Data extraction questionnaire

Patient Demographics				
Age		**Code**		
	Male	Female		
Sex				
	Single	Married	Widowed	Divorced
Marital Status				
	None	Primary	High School	Tertiary
Level of Education				
	Yes	Ex Smoker	Never	
Smoking				
	Yes	No	Previous Intake	
Alcohol				

Clinical Parameters					
Weight (Kg)			Height (m)		
BMI (Kg/m^2)			Obese(BMI ≥25)		
Duration of Diabetes			Diabetes Medication		
Hypertension Medications			Cholesterol Medication		
BP readings			BSL readings		

Laboratory Results					
HbA1c (%)		Urine Dipstick			
Urine Albumin		Serum creatinine (mmol/l)			
Hb		Urea /Na/K/Cl			
HGT Result		eGFR			
Total Cholesterol		HDL		LDL	

Diabetes Complications			
Retinopathy	Yes		No
If yes visual acuity			
Cataracts	Yes		No
If yes	Left	Right	Bilateral
Neuropathy	Yes		No
Diabetic Foot	Yes		No
Previous diagnosis of kidney disease in the past	Yes		No

Source: Dr Naledi Radikara

CKD staging of patient

Stage	Description	GFR (mL/min/1.73m^2)	CKD stage of patient (Please tick)
1	Kidney Damage With normal or ↑GFR	≥90	
2	Kidney Damage With mild or ↓ GFR	60-89	
3	Kidney Damage With Moderate ↓ GFR	30-59	
4	Kidney Damage With Severe ↓ GFR	15-29	
5	Kidney Failure	<15 (or dialysis)	

Adapted from National Kidney Foundation (NKF) KDQI Guidelines [1]

Audit tool for the management of CKD in Diabetes

Criterion	Yes	No
Is target HbA1c of <7 % achieved		
If hypertensive is BP target of <130/80 achieved		
Is a combination of ACE-I or ARB with a diuretic used for BP management?		
If diabetic and normotensive with microalbuminuria has the patient been offered ACE-I or ARB's?		
Is the Low Density Lipoprotein cholesterol (LDL-C) <100mg/dL?		
If LDL >100mg/dL has statin therapy been offered?		
Is dietary protein restriction part of the management plan?		
Is target BMI (18.5 – 24.5kg/m^2) reached and maintained?		

Source: SEMDSA guidelines. [17]